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(54) COLD ROLLED STEEL SHEET

(57)Abstract:

PURPOSE: To compatibly realize strengthening of image clarity and improvement of press workability by improving the image clarity and the press workability.

CONSTITUTION: On a cold rolled sheet on which different roughnesses are provided respectively on the surface and back face of the sheet by executing temper rolling on it through a set of upper and lower rolling rolls different in roughness, random projecting and recessed parts having a 0.6-1.1 $\mu$ m average roughness Ra each are mounted on one surface and random projecting and recessed parts having a 1.2-2.2 $\mu$ m average roughness Ra each are mounted on the other surface. Consequently, a waviness component of long wave length is restrained by low roughness, the press workability is improved by improvement of the image clarity after coating, and improved effect of oil reserving due to high roughness finishing and both the high image clarity and the press workability of an automobile steel sheet are improved completely.

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ABSTRACT:

**PURPOSE:** To compatibly realize strengthening of image clarity and improvement of press workability by improving the image clarity and the press workability.

**CONSTITUTION:** On a cold rolled sheet on which different roughnesses are provided respectively on the surface and back face of the sheet by executing temper rolling on it through a set of upper and lower rolling rolls different in roughness, random projecting and recessed parts having a  $0.6-1.1\mu\text{m}$  average roughness  $R_a$  each are mounted on one surface and random projecting and recessed parts having a  $1.2-2.2\mu\text{m}$  average roughness  $R_a$  each are mounted on the other surface. Consequently, a waviness component of long wave length is restrained by low roughness, the press workability is improved by improvement of the image clarity after coating, and improved effect of oil reserving due to high roughness finishing and both the high image clarity and the press workability of an automobile steel sheet are improved completely.

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CLAIMS

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[Claim(s)]

[Claim 1] The cold rolling plate characterized by having prepared the random irregularity whose average-of-roughness-height Ra is 0.6-1.1 micrometers in one field, and preparing the random irregularity whose average-of-roughness-height Ra is 1.2-2.2 micrometers in the field of another side in the cold-rolled plate which prepared roughness different, respectively in the steel plate table rear face by giving and carrying out temper rolling of the roughness which is different in the work roll for rolling of 1 set of upper and lower sides.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Industrial Application] this invention relates to the cold rolling plate with which the ambivalence ability which, on the other hand, boils the image clarity after painting outside, and has press workability differs.

[0002]

[Description of the Prior Art] Generally, although sheathing steel plates, such as the automobile body and home electronics, carry out paint finishing and a fine sight is given, to excel in the so-called image clarity [ say / making it not spoil a fine sight by the scattered reflection of a painted surface in this case ] is demanded. By making [ many ] the rate of improving the surface roughness profile of a steel plate, lessening paint surface irregularity after paint, and occupying for a horizontal level there, improvement in the regular reflectance of light and distortion of a map are lessened, and JP,3-38923,B is known as a steel plate which may raise the image clarity after paint conventionally. Moreover, while the amplitude of a crest and a trough becomes large, therefore the irregularity of a painted surface becomes intense, producing the scattered reflection of light and spoiling glossiness, non-\*\* of a map is invited, the fall of image clarity is caused, and image clarity is made to deteriorate, so that center line surface roughness Ra is large, although it is the steel plate for paint more marked than before which may be raised about image clarity like JP,3-39761,B.

[0003] Moreover, when a surface roughness profile is improved in temper rolling like JP,3-47925,B using the work roll which carried out laser beam machining and the conditions of the cold rolling process before that are unsuitable, the defect called the Yuzu skin in a paint film side arises, and image clarity deteriorates. Even if the wave has arisen on the front face of a dull roll, that wave is imprinted by the steel plate, a wave arises in a steel plate and this cause carries out temper rolling of that steel plate with a laser dull roll, it is for a wave not to disappear. And if it paints to such a steel plate, it will be said that the component of kneading already remains in a painted surface, and image clarity falls.

[0004] On the other hand, the cold rolled steel plate for processing carries out dull finish of the steel plate front face, in order to make press working of sheet metal easy to carry out. That is, it is because the operation which the lubricating oil for processing is stored by the irregularity formed in the steel plate front face at the time of press working of sheet metal, and lessens wear of metal mold and a steel plate, and prevents printing is carried out. Moreover, although research on press moldability is done from both sides of a molding technique the griddle side which is a material, the demand characteristics over a steel plate are upgrading and diversifying it more with highly-precise-izing and complication of a product. For this reason, the work roll which carried out dull processing of the steel plate roughness by shot blasting, discharge, or laser in the temper rolling finally adjusted as the present condition is used, and granularity is imprinted on the steel plate front face.

[0005]

[Problem(s) to be Solved by the Invention] As mentioned above, by making [ many ] the rate of lessening paint surface irregularity after paint and occupying for a horizontal level, improvement in the

regular reflectance of light and distortion of a map are lessened, and generating of the steel plate surface waviness after cold rolling of a tandem is prevented, it prevents that the wave of the steel plate after temper rolling arises by this, and the image clarity after paint is raised. If center line surface roughness  $R_a$  is enlarged on the other hand in order to raise press workability, while the amplitude of a crest and a trough will become large, therefore the irregularity of a painted surface will become intense, producing the scattered reflection of light and spoiling gloss, distortion of a map is caused and the fall of image clarity is caused, and it will deteriorate and will be said for the double-sided repulsion of the image clarity that it carries out. It is the purpose of this invention to realize this opposite enhancement of image clarity and opposite improvement of press workability compatible, and to aim at advantageous solution about an improvement of image clarity and press workability.

[0006]

[Means for Solving the Problem] This invention solves the above problems, enhancement and the other sides of image clarity aim at an improvement of press workability, and one side has them in the both \*\*\*\*\* cold rolling plate of image clarity and press workability. The place made into the summary of the invention is in the cold rolling plate characterized by having prepared the random irregularity whose average-of-roughness-height  $R_a$  is 0.6-1.1 micrometers in one field, and preparing the random irregularity whose average-of-roughness-height  $R_a$  is 1.2-2.2 micrometers in the field of another side in the cold-rolled plate which prepared roughness different, respectively in the steel plate table rear face by giving and carrying out temper rolling of the roughness which is different in the work roll for rolling of 1 set of upper and lower sides.

[0007]

[Function] This invention is explained to a detail below. In order to prevent that a wave occurs on the steel plate front face after cold rolling of a tandem in this invention, to prevent that a wave arises in the steel plate after temper rolling by this and to prevent the fall of the image clarity of the painted surface after paint In manufacture of cold rolled sheet steel It prevents that a wave occurs on the steel plate front face after cold rolling using the work roll which formed surface roughness so that the random irregularity whose average-of-roughness-height  $R_a$  of the steel plate after temper rolling is 0.6-1.1 micrometers might be first imprinted by the work roll of the last stand of a tandem cold rolling mill. Moreover, the pattern on the front face of a work roll is imprinted on a steel plate front face by carrying out temper rolling using the work roll which formed the microscopic configuration in the front face beforehand as a work roll for temper rolling using the high density energy source.

[0008] In addition, when the roughness with which the reason which average-of-roughness-height  $R_a$  set to 0.6 micrometers or more was imprinted by formation of the surface roughness of the work roll of the last stand of a cold rolling mill on the steel plate front face is less than 0.6 micrometers, although it does not generate, printing becomes easy to generate a wave at the time of press working of sheet metal. Moreover, when it will be easy to generate a wave if the reason set to 1.1 micrometers or less exceeds 1.1 micrometers, therefore making it average-of-roughness-height  $R_a$  set to 0.6 micrometers - 1.1 micrometers, the wave on the front face of a steel plate after the ultimate-pressure total of a tandem cold rolling mill can be prevented. Thus, the component of a wave does not carry out raw to the steel plate front face after temper rolling, but it becomes possible to prevent degradation of the image clarity on the front face of paint by the wave. That is, by stopping a long wavelength external waviness component low with low roughness, a wave is prevented and the image clarity after paint is raised.

[0009] It is in on the other hand having prepared the random irregularity whose average-of-roughness-height  $R_a$  is 1.2-2.2 micrometers in the field of another side. It is an element with the surface roughness of a steel plate most important for press-forming nature, and surface roughness is required also in order to control generating of die galling by controlling a contact condition with a press die. That is, average-of-roughness-height  $R_a$  becomes easy to generate printing in less than 1.2 micrometers at the time of press working of sheet metal. Moreover, if it exceeds 2.2 micrometers, the image clarity after paint will not become good enough, but by preparing the random irregularity in within the limits of 1.2-2.2 micrometers, the improvement effectiveness in a sump ball by random roughness grant is planned, and  $R_a$  can improve press-forming nature.

[0010] Drawing 1 is drawing showing the microscopic gestalt by the microphotography of a cold rolling plate front face. As shown in drawing 1, it turns out with low roughness that the condition that the long wavelength external waviness component was able to be stopped low is shown. Drawing 2 is drawing showing the microscopic gestalt by the microphotography on the rear face of a cold rolling plate. As shown in drawing 2, random concave convex voice is shown. The improvement effectiveness of the sump ball by this random high roughness finishing is planned, and the good plate of press-forming nature is obtained.

[0011] Drawing 3 is drawing showing the cylinder deep-drawing shaping trial of the cold rolled sheet steel of this invention. As an evaluation test of the inner plate for automobiles, the existence (a press and workability) of a crack was investigated after processing, and the marginal contraction ratio (L, D, R) estimated. This L, D, and R ask for the diameter of the maximum blank which can carry out deep drawing using the metal mold of diameter D of punch 32mm, and ask for it from the ratio of that diameter of the maximum blank and diameter of punch. The sign 1 of a steel plate and 2 is [ a dice and 3 ] punch. consequently, drawing 4 the steel plate of this invention indicates a press workability evaluation result to be -- L, D, and R 2.35 of the conventional material -- it is -- it receives, and L of this invention material, D, and an R value are as high as 2.45, and deep drawability and die-galling-proof nature are excellent. In addition, although the above has been explained centering on a steel plate, it is possible for it not to be limited to a steel plate and to apply also to an aluminum plate at a hot-dip zinc-coated carbon steel sheet, an electroplating steel plate, and a stainless steel plate list. Stainless steel

[0012]

[Effect of the Invention] As stated above, as compared with the conventional steel plate, by stopping a long wavelength external waviness component low with low roughness, the image clarity after paint was raised, and press-forming nature has been improved according to the improvement effectiveness of the sump ball by high roughness finishing, and the improvement of press workability was completely achieved with the high image clarity of the steel plate for automobiles.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] Drawing showing the microscopic gestalt by the microphotography of a cold rolling plate front face,

[Drawing 2] Drawing showing the microscopic gestalt by the microphotography on the rear face of a cold rolling plate,

[Drawing 3] Drawing showing the cylinder deep-drawing shaping trial of the cold rolled sheet steel of this invention,

[Drawing 4] It is drawing showing a press workability evaluation result.

[Description of Notations]

1 Steel Plate

2 Dice

3 Punch

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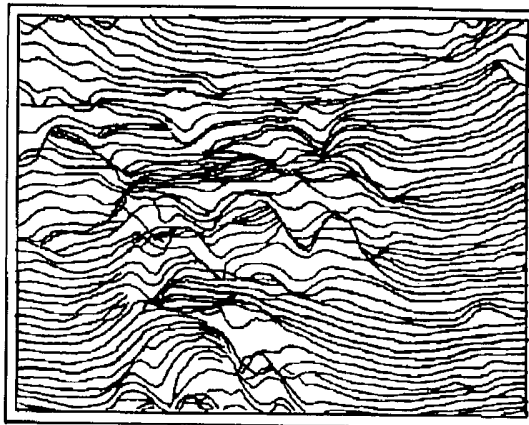
(54)【発明の名称】 冷間圧延板

(57)【要約】

【目的】 鮮映性の補強とプレス加工性の改善とを両立的に実現するためのもので、鮮映性およびプレス加工性の改善に関して有利に解決を図ること。

【構成】 上下1組の圧延用ワークロールに異なる粗度を付与し、調質圧延することによって鋼板表裏面にそれぞれ異なる粗度を設けた冷延板において、一方の面には平均粗さRaが0.6~1.1μmのランダムな凹凸を設け、他方の面には平均粗さRaが1.2~2.2μmのランダムな凹凸を設けた冷間圧延板。

【効果】 従来の鋼板に比較し、低粗度で長波長うねり成分を低く抑えることにより、塗装後の鮮映性を向上させ、かつ高粗度仕上げによる油溜まり向上効果により、プレス加工性が改善され、自動車用鋼板の高鮮映性と共にプレス加工性の改善が完全に図られた。





## 【特許請求の範囲】

【請求項1】 上下1組の圧延用ワークロールに異なる粗度を付与し、調質圧延することによって鋼板表裏面にそれぞれ異なる粗度を設けた冷延板において、一方の面には平均粗さRaが0.6～1.1 $\mu$ mのランダムな凹凸を設け、他方の面には平均粗さRaが1.2～2.2 $\mu$ mのランダムな凹凸を設けたことを特徴とする冷間圧延板。

## 【発明の詳細な説明】

## 【0001】

【産業上の利用分野】本発明は外面に塗装後の鮮映性を他面にプレス加工性を有する両面性能の異なる冷間圧延板に関するものである。

## 【0002】

【従来の技術】一般的に、自動車ボディや家電製品などの外装鋼板は塗装仕上げをして美観を付与するが、この際塗装面の乱反射によって美観を損なわないようにするという、いわゆる鮮映性に優れていることが要求される。そこで、例えば鋼板の表面粗度プロフィールを改良して、塗装後の塗装表面凹凸を少なくし水平部分の占める割合を多くすることによって、光の正反射率の向上と写像の歪みを少なくして、塗装後の鮮映性を従来よりも向上させ得る鋼板として、特公平3-38923号公報が知られている。また、特公平3-39761号公報のように、鮮映性を従来よりも格段の向上させ得る塗装用鋼板であるが、中心線表面粗さRaが大きいほど、山と谷の振幅が大きくなり、そのため塗装面の凹凸が激しくなり、光の乱反射を生じて光沢性を損なうとともに、写像の歪みを招いて写像性の低下を招き、鮮映性を劣化させることになる。

【0003】また、特公平3-47925号公報のように、調質圧延において、レーザ加工したワークロールを用いて表面粗度プロフィールを改良した場合でも、その前の冷間圧延工程の条件が不適切な場合には、塗膜面にゆず肌と称される欠陥が生じて鮮映性が劣化する。この原因はダルロールの表面にうねりが生じており、そのうねりが鋼板に転写されて鋼板にうねりが生じ、その鋼板をレーザダルロールで調質圧延しても、うねりが消えないためである。そしてこのような鋼板に塗装を施せば、塗装面にもうねりの成分が残って鮮映性が低下すると言うものである。

【0004】一方、加工用冷間圧延鋼板はプレス加工し易くするため、鋼板表面をダル仕上げる。すなわち、プレス加工時鋼板表面に形成された凹凸に加工用潤滑油が貯留され、金型と鋼板の摩耗を少なくし、かつ焼付けを防止する作用をするからである。また、プレス成型性に関する研究は、素材である鉄板側と成型技術の両面から行われているが、製品の高精度化と複雑化に伴い鋼板に対する要求特性がより高級化、多様化しつつある。このため現状としては、鋼板粗度を最終的に調整する調質

圧延において、ショットブラスト、放電あるいはレーザ等でダル加工したワークロールを使用し、鋼板表面に粗さを転写している。

## 【0005】

【発明が解決しようとする課題】上述したように、塗装後の塗装表面凹凸を少なくし水平部分の占める割合を多くすることによって、光の正反射率の向上と写像の歪みを少なくし、かつ、タンデムの冷間圧延後の鋼板表面うねりの発生を防止し、これによって調質圧延後の鋼板のうねりが生じることを防止して塗装後の鮮映性を向上させる。一方プレス加工性を高めるために中心線表面粗さRaを大きくすると山と谷の振幅が大きくなり、そのため塗装面の凹凸が激しくなり、光の乱反射を生じて光沢を損なうと共に、写像の歪みを招いて写像性の低下を招き、鮮映性を劣化するという両面相反することになる。この相反する鮮映性の増強とプレス加工性の改善とを両立的に実現しようとするもので、鮮映性およびプレス加工性の改善に関して有利な解決を図ることが、この発明の目的である。

## 【0006】

【課題を解決するための手段】本発明は上述のような問題を解消し片面は鮮映性の増強と他面はプレス加工性の改善を図り、鮮映性およびプレス加工性の両者優れた冷間圧延板にある。その発明の要旨とするところは、上下1組の圧延用ワークロールに異なる粗度を付与し、調質圧延することによって鋼板表裏面にそれぞれ異なる粗度を設けた冷延板において、一方の面には平均粗さRaが0.6～1.1 $\mu$ mのランダムな凹凸を設け、他方の面には平均粗さRaが1.2～2.2 $\mu$ mのランダムな凹凸を設けたことを特徴とする冷間圧延板にある。

## 【0007】

【作用】以下本発明について詳細に説明する。本発明においてはタンデムの冷間圧延後の鋼板表面にうねりが発生することを防止し、これによって調質圧延後の鋼板にうねりが生じることを防止して、塗装後の塗装面の鮮映性の低下を防止するために、冷延鋼板の製造において、先ずタンデム冷間圧延機の最終スタンドのワークロールに調質圧延後の鋼板の平均粗さRaが0.6～1.1 $\mu$ mのランダムな凹凸が転写されるように表面粗度を形成したワークロールを使用して冷間圧延後の鋼板表面にうねりが発生することを防止する。また、調質圧延用のワークロールとしては、予めその表面に高密度エネルギー源を使用して微視的形状を形成したワークロールを用い、調質圧延することによりワークロール表面の模様を鋼板表面に転写するものである。

【0008】なお、平均粗さRaが0.6 $\mu$ m以上とした理由は、冷間圧延機の最終スタンドのワークロールの表面粗度の形成によって鋼板表面に転写された粗度が0.6 $\mu$ m未満の場合は、うねりは発生しないがプレス加工時において焼付けが発生し易くなる。また、1.1

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$\mu\text{m}$ 以下とした理由は、1.  $1\mu\text{m}$ を超えるとうねりが発生し易く、そのため平均粗さRaが $0.6\mu\text{m}\sim 1.1\mu\text{m}$ になるようにすることによって、タンデム冷間圧延機の最終圧延後の鋼板表面のうねりを防止することが出来る。このように調質圧延後の鋼板表面にうねりの成分が生ぜず、うねりによる塗装表面の鮮映性の劣化を防止することが可能となる。すなわち、低粗度で長波長うねり成分を低く抑えることにより、うねりを防止し塗装後の鮮映性を向上させるものである。

【0009】一方、他方の面には平均粗さRaが $1.2\sim 2.2\mu\text{m}$ のランダムな凹凸を設けたことにある。鋼板の表面粗度は、プレス成形性にとって最も重要な要素であり、プレス型との接触状態を制御することによって型かじりの発生を抑制するためにも表面粗度は必要である。すなわち、平均粗さRaが $1.2\mu\text{m}$ 未満ではプレス加工時において焼付けが発生し易くなる。また、 $2.2\mu\text{m}$ を超えると塗装後の鮮映性が十分に良好とならず、Raは $1.2\sim 2.2\mu\text{m}$ の範囲内でのランダムな凹凸を設けることにより、ランダムな粗度付与による油溜まり向上効果が図られ、プレス成形性を改善することが出来る。

【0010】図1は冷間圧延板表面の顕微鏡写真による微視的形態を示す図である。図1に示すように、低粗度で長波長うねり成分を低く抑えられた状態が示されていることがわかる。図2は冷間圧延板裏面の顕微鏡写真による微視的形態を示す図である。図2に示すように、ランダムな凹凸状態を示している。このランダムな高粗度仕上げによる油溜まりの向上効果が図られ、プレス成形性の良好な板が得られる。

【0011】図3は本発明の冷延鋼板の円筒深絞り成形試験を示す図である。自動車用内板の評価テストとして、加工後にひび割れの有無（プレス・加工性）を調査

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し、かつ限界絞り比（L, D, R）にて評価した。このL, D, Rはボンチ径D32mmの金型を用いて深絞りしうる最大素板径を求め、その最大素板径とボンチ径との比から求めたものである。符号1は鋼板、2はダイス、3はボンチである。その結果、本発明の鋼板は、プレス加工性評価結果を示す図4より、従来材のL, D, Rが2.35であるに対して本発明材のL, D, R値は2.45と高く、深絞り性および耐型かじり性が優れている。なお、以上は鋼板を中心に説明してきたが、鋼板に限定されるものでなく、溶融亜鉛めっき鋼板、電気めっき鋼板及びステンレス鋼板並びにアルミニウム板にも適用することが可能である。

【0012】

【発明の効果】以上述べたように、従来の鋼板に比較し、低粗度で長波長うねり成分を低く抑えることにより、塗装後の鮮映性を向上させ、かつ高粗度仕上げによる油溜まりの向上効果により、プレス成形性が改善され、自動車用鋼板の高鮮映性と共にプレス加工性の改善が完全に図られた。

【図面の簡単な説明】

【図1】冷間圧延板表面の顕微鏡写真による微視的形態を示す図、

【図2】冷間圧延板裏面の顕微鏡写真による微視的形態を示す図、

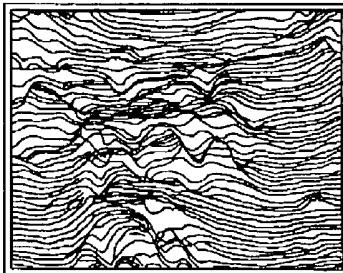
【図3】本発明の冷延鋼板の円筒深絞り成形試験を示す図、

【図4】プレス加工性評価結果を示す図である。

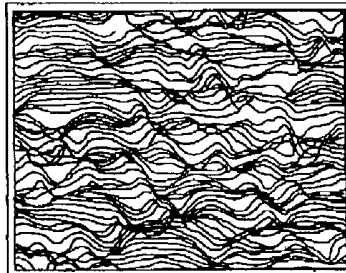
【符号の説明】

- 1 鋼板
- 2 ダイス
- 3 ボンチ

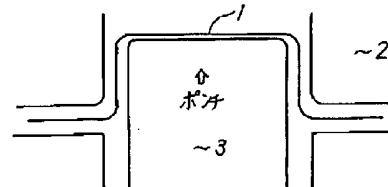
【図1】



【図2】



【図3】



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【図4】

